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Borealis Technical Limited  
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EXAMINER

TAMAI, KARL I

ART UNIT PAPER NUMBER

2834

DATE MAILED: 06/26/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

### Application No.

09/481,803

### Applicant(s)

TAVKHELIDZE ET AL.

### Examiner

Tamai IE Karl

### Art Unit

2834

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 03 April 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-4, 6-10, 13-17, 23-37 and 43-68 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 6 is/are allowed.
- 6) ☒ Claim(s) 1-4, 7-10, 13-17, 23-34, 36, 37, 43-46, 49-65, 67 and 68 is/are rejected.
- 7) ☒ Claim(s) 35, 48 and 66 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 14 September 2001 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

### Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 17.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

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## **DETAILED ACTION**

### ***Drawings***

1. The objection to the drawings is withdrawn.

### ***Specification***

2. The amended title "Thermionic Vacuum Diode Device with Adjustable Electrodes" has been entered into the file wrapper. The requirement for a new title is withdrawn.

### ***Drawings***

3. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the thermal interface connecting the housing and the collector, must be shown or the features canceled from the claims. No new matter should be entered.

A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

### ***Claim Rejections - 35 USC § 112***

4. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

5. Claims 43-49, 63, and 64 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention. The specification does not contain a full, clear, concise, and exact written description of a thermal interface connecting the housing and the collector. The specification does not have a full, clear, concise, and exact written description of a solvent dissolving the first material.

***Claim Rejections - 35 USC § 102***

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

7. Claims 1-2 and 7 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Kennel (US 5410166). Kennel teaches a thermal conversion device having a source of electron tunneling (voltage source) connected to the emitter which when pulsed, produced an electron tunnel to the anode 104, where the anode can be manipulated at 108. The electrons being tunneled from the emitter to the anode 104

across a small gap 110. Kennel teaches the emitter and collector connected a circuit as a thermionic generator or switch. The thermionic generator being in a housing 102 is flexible to allow the movement of the manipulating means and the anode 104. It is inherent that the manipulator 108 includes some form of means for assessing the electrode distance.

8. Claims 1, 2, 4, 7, 23, and 24 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Hatsopoulos and Gyftopoulos (H&G). H&G teach thermionic diode having a flat emitter and collector. H&G teach a manipulator(spacing adjustment mechanism) to control the relative spacing of the electrodes. It is inherent that a power converter is connected to an electrical load. H&G teaches thermionic converter in a vacuum housing which is flexible to allow the movement of the electrodes. H&G shows the electrode adjustment means which is activated by a human and which inherently can determine the spacing of the electrodes. It is inherent that the spacing between the electrodes is sufficiently small to allow for electron tunneling.

9. Claims 1, 2, 8-16, 23, 24, and 27 are rejected under 35 U.S.C. 102(e) as being clearly anticipated by DiMatteo (US 6,084,173). DiMatteo teaches an energy converter having an emitter 1 connected to a heat source and a collector 2 connected to a cool source, which is connected to a circuit as photovoltaic (sunlight) generator and is inherently positioned in a flexible housing which allows the adjustment of the electrodes.

DiMatteo teaches piezoelectric actuators to adjust the position of the electrodes, which inherently includes a control means for the electrodes.

10. Claims 23 and 28 are rejected under 35 U.S.C. 102(e) as being clearly anticipated by Rason et al.(Rason)(US 3,843,896). Rason teaches a diode with flat matching surfaces between the electrodes. Rason teaches the emitter and collector made from different materials, which inherently have different coefficients of thermal expansion.

11. Claims 1, 2, 7-10, 13, 14, 23, 24, 27, 50, 53, and 61 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Fitzpatrick et al. ("Close-Spaced Thermionic Converters with Active Spacing Control and Heat Pipe Isothermal Emitters). Fitzpatrick teaches a thermionic generator with matching emitters and collectors having flat surfaces. The spacing is controlled by piezoelectric motors and the spacing is measured by measuring the capacitance, where the distance separating the electrodes is always controlled by the control means. It is inherent that the electrodes are space sufficiently small to allow electron tunneling therebetween to allow the device to operate as a generator. The generator having hot and cold heat pipes connected to the emitter and collector. Fitzpatrick teaching the heat energy can be solar.

12. Claims 23, 33, and 65 are rejected under 35 U.S.C. 102(e) as being clearly anticipated by Cox (US 6,064,137). Cox clearly teaches two opposing electrodes with

matching surfaces and having a second removable material which is removed by a solution and a vacuum.

***Claim Rejections - 35 USC § 103***

13. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

14. Claims 3 and 43 is rejected under 35 U.S.C. 103(a) as being unpatentable over H&G, Kennel, Fitzpatrick, or DiMatteo, in further view of Rason et al.(Rason)(US 3,843,896). H&G, Kennel, and DiMatteo, each individually teach every aspect of the invention except the housing being thermally conductive with the collector thermally connected to the housing. Rason teaches a conductive housing to allow heat to pass in and out of the converter. It would have been obvious to a person of ordinary skill in the art at the time of the invention to construct the energy converter of H&G, Kennel, or DiMatteo with the conductive housing of Rason to allow heat pass into the energy convert to generate electricity.

15. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over H&G, Kennel, Fitzpatrick, or DiMatteo, in further view of Yasuda(US 5,487,790). H&G,

Kennel, and DiMatteo, each individually teach every aspect of the invention except the metal powder on the electrodes. Yasuda teaches a metal powder on the collector electrode. It would have been obvious to a person of ordinary skill in the art at the time of the invention to construct the energy converter of H&G, Kennel, or DiMatteo with the metal powder on the electrodes because Yasuda teaches to help efficiently convert solar heat to electricity.

16. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over DiMatteo, in further view of Cox(US 6,6064,137). DiMatteo teaches every aspect of the invention except a voltage source to operate the device as a heat pump. Cox teaches it is know to provide a voltage source 23 to a thermionic converter to operate the device as a heat pump. It would have been obvious to a person skilled in the art at the time of the invention to construct the converter of DiMatteo with the voltage source of Cox to operate the device as a heat pump.

17. Claims 25, 26, and 54-56 are rejected under 35 U.S.C. 103(a) as being unpatentable over DiMatteo or H&G or Fitzpatrick. DiMatteo and H&G, each individually teach every aspect of the invention except the collector and emitter positioned within 200, 100, or 10 angstroms. It would have been obvious to a person skilled in the art at the time of the invention to construct the diode of DiMatteo or H&G with the electrode spacing of 200 or 100 angstroms to provide and small air gap to reduce thermionic leakage around the collector.



18. Claims 28-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fitzpatrick, in further view of Richards(US 4,281,280) and Edelson(US 5,874,039). Fitzpatrick teaches every aspect of the invention except the collector being aluminum and emitter being titanium with a difference of thermal expansion being 4-1. Richards teaches aluminum is a known anode material. Edelson teaches titanium is a known emitter material. It would have been obvious to a person skilled in the art at the time of the invention to construct the energy converter of Rason with the aluminum anode of Richards and the titanium emitter of Edelson because mere selection of known parameters is within the ordinary skill in the art and because Richards and Edelson teaches the materials are sufficient for electrode structures in thermionic converters.

19. Claims 29-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rason, in further view of Richards(US 4,281,280) and Edelson(US 5,874,039). Rason and Fitzpatrick teach every aspect of the invention except the collector being aluminum and emitter being titanium with a difference of thermal expansion being 4-1. Richards teaches aluminum is a known anode material. Edelson teaches titanium is a known emitter material. It would have been obvious to a person skilled in the art at the time of the invention to construct the energy converter of Rason or Fitzpatrick with the aluminum anode of Richards and the titanium emitter of Edelson because mere selection of known parameters is within the ordinary skill in the art and because

Richards and Edelson teaches the materials are sufficient for electrode structures in thermionic converters.

20. Claim 34 is rejected under 35 U.S.C. 103(a) as being unpatentable over Cox. Cox teaches every aspect of the invention except positioning the electrodes within 200 or 100 angstroms. It would have been obvious to a person skilled in the art at the time of the invention to construct the diode of Cox with the electrode spacing of 200 or 100 angstroms to provide an efficient and small air gap to reduce thermionic leakage around the collector.

21. Claims 36 is rejected under 35 U.S.C. 103(a) as being unpatentable over Cox in further view of Fitzpatrick et al. ("Close-Spaced Thermionic Converters with Active Spacing Control and Heat Pipe Isothermal Emitters). Cox teaches every aspect of the invention except the moveable electrodes Fitzpatrick teaches movable electrodes to provide high power densities. It would have been obvious to a person of ordinary skill in the art at the time of the invention to construct the generator of Cox with the moving electrodes of Fitzpatrick to provide high density output.

22. Claim 37 is rejected under 35 U.S.C. 103(a) as being unpatentable over Fitzpatrick (US 4,667,126)('126) and Fitzpatrick ("Close-Spaced Thermionic Converters with Active Spacing Control and Heat Pipe Isothermal Emitters). '126 teaches a thermionic converter with an electrodes space spaced apart in an inert gas with the

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electrode thermally adjustable (col. 4, lines 17-19) where the thermally activated member 38 is connected to the face of the electrode 24. '126 does not teach a electroactive, magnetostrictive, or piezoelectric control of the electrode spacing or a spacing of 1-100 angstroms. Fitzpatrick teaches the gap adjustor being a piezoelectric device. It would have been obvious to a person skilled in the art at the time of the invention to construct the converter of '126 with the piezoelectric drive of Fitzpatrick to provide improved control of the gap due to vibrations, and with the gap space of 1-100 angstroms to optimize the efficiency of the converter (see *In re Aller*, 105 USPQ 233, holding where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art).

23. Claim 44-47 and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over H&G, Kennel, Fitzpatrick, or DiMatteo, in further view of Monroe, Jr.(4,040,903) and Synder Jr. et al. (US 4,224,461). H&G, Kennel, and DiMatteo, each individually teach every aspect of the invention except the emitter and collector being mounted on aluminum power. Monroe teaches the emitter and collector mounted on AL<sub>2</sub>O<sub>3</sub> to electrically insulate the electrodes and to promote rapid heat transfer. Monroe does not teach the material being a powder. Synder teaches that aluminum oxide can be applied as a spray coating. It would have been obvious to a person of ordinary skill in the art at the time of the invention to construct the energy converter of H&G, Kennel, or DiMatteo with the electrodes mounted on AL<sub>2</sub>O<sub>3</sub> because Monroe teaches it allows for rapid

thermal transfer, and with the material being a powder because Synder teaches the material can be easily applied by spray coating.

24. Claim 51 is rejected under 35 U.S.C. 103(a) as being unpatentable over Fitzpatrick ("Close-Spaced Thermionic Converters with Active Spacing Control and Heat Pipe Isothermal Emitters) and Richards(US 4281280). Fitzpatrick teaches every aspect of the invention except the measuring means being an apparatus for measuring tunneling current. Richards teaches the output of a thermal generator is controlled by monitoring the output voltage or current. It would have been obvious to a person of ordinary skill in the art at the time of the invention to construct the machine of Fitzpatrick with an ammeter and the control means because Richards teaches that the generator can be controlled to provide an optimum output.

25. Claim 52 is rejected under 35 U.S.C. 103(a) as being unpatentable over Fitzpatrick ("Close-Spaced Thermionic Converters with Active Spacing Control and Heat Pipe Isothermal Emitters) and Sliwa Jr. (US 5307311). Fitzpatrick teaches every aspect of the invention except the measuring means being an optical interferometry. Sliwa teaches the equivalence of optical interferometry and capacitance sensors in positioning piezoelectric micro-actuators. It would have been obvious to a person of ordinary skill in the art at the time of the invention to construct the machine of Fitzpatrick with an optical interferometry because Silwa teaches that optical interferometry is used to control

piezoelectric actuators and because it is within the ordinary skill in the art to choose between known equivalents.

26. Claims 57-60 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fitzpatrick ("Close-Spaced Thermionic Converters with Active Spacing Control and Heat Pipe Isothermal Emitters), as discussed above, and Richards(US 4281280). Fitzpatrick teaches every aspect of the invention except the region between the electrodes being evacuated or having an inert gas such as argon. Richards teaches the region between the electrodes can be either evacuated or filled with an inert gas such as argon. It would have been obvious to a person of ordinary skill in the art at the time of the invention to construct the machine of Fitzpatrick with the region between the electrodes being evacuated or filled with argon because Richards teaches that the vacuum or argon allows the electrons in the gas to be charged and flow between the electrodes when heat is applied to the cathode.

27. Claim 61 is rejected under 35 U.S.C. 103(a) as being unpatentable over Fitzpatrick ("Close-Spaced Thermionic Converters with Active Spacing Control and Heat Pipe Isothermal Emitters) and Cox, as discussed above, and Richards(US 4281280). Fitzpatrick and Cox teach every aspect of the invention except the inert gas being argon. Richards teaches the region between the electrodes can be either evacuated or filled with an inert gas such as argon. It would have been obvious to a person of ordinary skill in the art at the time of the invention to construct the machine of Fitzpatrick

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and Cox with the region between the electrodes being evacuated or filled with argon because Richards teaches that the vacuum or argon allows the electrons in the gas to be charged and flow between the electrodes when heat is applied to the cathode.

28. Claim 67 and 68 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cox. Cox teaches every aspect of the invention except second material being lead and the third material is aluminum. It would have been obvious to a person skilled in the art at the time of the invention to construct the diode of Cox with the second material being lead and the third material is aluminum as a matter of design choice to optimize the manufacture of the generator.

#### ***Allowable Subject Matter***

29. Claim 6 is allowed.

30. Claim 35, 48, and 66 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

#### ***Response to Arguments***

31. Applicant's arguments filed 9/14/01 have been fully considered but they are not persuasive.

The Applicant's argument regarding Kennel is not persuasive. The free electrons tunnel from the diamond crystal emitters 116-126 to the anode 104 across the air gap.

The Applicant's argument regarding the manipulator is not persuasive. It is clearly used to operate the device and set the spacing between the emitter and anode. The Applicant's arguments regarding the spacing of H&G is not persuasive. In order for the device of H&G to operate as a thermionic generator, it must be inherent that the spacing between electrodes is sufficiently small to allow tunneling of the electrons from the emitter to the collector. The Applicant's argument regarding claim 23 is not persuasive. H&G show the emitter and collector having matching flat surfaces opposite each other. Applicant's arguments regarding the spacing of DiMatteo is not persuasive. In order for the device of to operate as an energy converter, it must be inherent that the spacing between electrodes is sufficiently small to allow tunneling of the electrons from the emitter to the collector. DiMatteo teaches the electrodes having matching flat surfaces. The Applicant's argument that Rason does not teach matching flat electrodes is not persuasive because Rason teaches flat electrodes 264 and 296. The Applicant's argument regarding the size of the electrodes is not persuasive because the electrodes 264 and 296 are shown as having the same size.

The Applicant's argument that there is prima facie case of obviousness is not persuasive. The Examiner has set out motivation for all the combinations of references as set forth above, where the motivation is set forth either in the references themselves or in the knowledge generally available to one of ordinary skill in the art (See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992)).

The Applicant's argument that Claim 3, 5, and 17 are allowable because Claim 1 is allowable is not persuasive because Claim 1 has been statutorily barred by three references. The Applicant's argument that Claim 25, 26, 29-32, and 33-37 are allowable because Claim 23 is allowable is not persuasive because Claim 23 has been statutorily barred by three references. The rejections are proper and maintained.

32. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Karl I.E. Tamai at (703) 305-7066. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Karl I.E. Tamai whose telephone number is (703) 305-7066.

The examiner can be normally contacted on Monday through Friday from 8:00 am to 4:00 pm. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mr. Nestor Ramirez, can be reached at (703) 308-1371. The facsimile number for the Group is (703) 305-3432.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956.

Karl I Tamai  
PRIMARY PATENT EXAMINER  
June 24, 2002

  
KARL TAMAI  
PRIMARY EXAMINER